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ABSTRACT

This report is based on a 1999 National Science Foundation (NSF) summit on the future of minority leadership in science and engineering. The summit examined what it would take to create, from among members of ethnic or racial minority groups, leaders with scientific, mathematical, and engineering skills and credentials. The purpose of the summit was to develop an effective action plan to present to universities, industry, government, and funding agencies that would give specific suggestions on ways to develop critical national minority leadership. The summit's discussions revolved around various dimensions of leadership (academic practices, the role of information, career paths, why sponsors matter, and subcultural differences in negotiating social reality). The NSF's role was examined. Proposed actions included: creating a national leadership academy with a fellows program, a site program, and a research and evaluation program; creating a coalition of minority science and technology associations; appointing a federal diversity coordinator; and disseminating this report to anyone interested in the issues addressed. Appended are: a selected bibliography and data sources; a list of summit participants; the meeting evaluation; a framework, "Lack of Minority Leadership: Possible Causes and Plausible Solutions" (Richard Tapia); and Web resources. (SM)

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ED 448 224

Promoting National Minority Leadership in Science and Engineering

A Report on Proposed Actions

Richard Tapia
Daryl Chubin
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National Science Foundation
Celebrating 50 Years

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Information About The Authors

The full report can also be accessed at http://ceee.rice.du/Books/DV/leadership/index.html.

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Individuals at Rice that we must thank who helped make the meeting a success include: Malcolm Gillis, President, Jordan Konisky, Vice President for Research and Graduate Studies, and Program Director for Rice's NSF-funded Alliances for Graduate Education and the Professoriate, Sidney Burrus, Dean of George R. Brown School of Engineering and Kathleen Matthews, Dean of Wiess School of Natural Sciences. We thank Priscilla Huston for contributing her time and talent to chronicling the meeting, and Theresa Chatman and Linda Neyra who worked tirelessly for months to make the meeting run smoothly.

We thank all those who attended the meeting and gave valuable input, in particular, Shirley Malcom for her insightful dinner keynote presentation. We appointed a reading committee that consisted of Baine Alexander, David Burgess, Carlos Castillo-Chavez, Roscoe Giles, Manuel Gomez, George Langford, Shirley Malcom, Cora Marrett, Juan Meza, Terry Millar, David Sanchez, and Luther Williams, and we thank those who gave us so many helpful comments.

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Foreword

In October 1998, the National Science Board held a special hearing in Puerto Rico which Shirley Malcom, Luther Williams, and I all attended. One late night, we were sitting in the hotel bar deep in conversation about common concerns, especially relating to underrepresented minorities in science and engineering. One of our very deep sorrows was the diminishing numbers of up-and-coming minority national leaders that we observed. We have all worked in this area for over 30 years, and while the minority population is expanding, leadership at the national level, with some very bright exceptions, seems to be shrinking.

Our conversation was the impetus for this meeting and report. We all determined then to look for ways that our bright, young, talented underrepresented minority colleagues could be propelled to the positions of leadership that they deserve and that this nation so desperately needs them to fill. Luther suggested that I hold a meeting, and we both convinced Shirley to open the meeting with this challenge. A year later we held the meeting, and a year later we have the report.

The meeting was exciting. The report has been difficult. If the solutions were simple, the problem would have been solved long ago. We hope that we have at least brought greater understanding to the topic.

Richard Tapia

NSF SUMMIT

Rice University

October 18-19, 1999

Promoting National Minority Leadership in Science and Engineering

A Report on Proposed Actions

The Problem

Often lost in analysis and discussion of "participation in science" is a key outcome of preparation, competition, accretion of experiences, and accomplishments – *leadership*. Who leads communities – academic, corporate, professional – depends at least as much on the culture of institutions and individual opportunity as the talent and achievements that become recognized as aggregate merit-based performance over a career.

Motivated by concern for future leadership, a "summit" of alarmed leaders, drawn largely from within science, engineering, and higher education, was held on October 18-19 at Rice University.* Unlike the typical focus on "minority participation in science and engineering" and the prerequisites for participation, the Summit addressed the pinnacle of status within the career – leadership. Specifically, what does it take to create, from among members of ethnic or racial minority groups, leaders with scientific, mathematical, and engineering skills and credentials?

The reason for this focus is clear to all who monitor trends in participation in science and engineering education and employment. Minority group members of interest – those categorized and reported as African Americans, Hispanic Americans, American Indians – are underrepresented in science, mathematics, and engineering relative to their numbers in the U.S. population, among high school graduates, and among those earning a baccalaureate degree. These "denominators" also indicate corollary trends: minorities do

* NSF Summit Meeting: Promoting National Minority Leadership in Science and Engineering, Rice University, Houston, TX, Oct. 18-19, 1999. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the National Science Board or the National Science Foundation.

not advance to successive stages of degree preparation in the same proportion as majority students.

Because there is a disproportionate attrition of minorities through the transitions of education and employment, retention strategies may take many forms.† Some may be directed to individuals who would benefit from information that can inform interests and choices in careers; others may seek to change organizational culture – the climate of the training site and the workplace – that welcomes some students and faculty, but deters others. While the goal of change may be increasing the numbers of minorities who choose to pursue a career in science or engineering, there is equal concern to change the quality of their experiences, of the environments that reward and punish, of the recognition that ethnic and racial diversity represents the strength of individual differences in talent to be nurtured and utilized. The ultimate benefit to the nation is a richer pool of science, mathematics, and engineering leaders.

Representation and Leadership

The interdependencies between "representation" and "leadership" are unmistakable. But they raise a host of questions: Must we solve the underrepresentation problem before we tackle the leadership problem? How can we cultivate leadership while restocking the meager pool of minority scientists and engineers? Do we celebrate or discourage these talented young professionals who become administrators rather than researchers and educators? How important is it that they develop and sustain a credible research reputation?

Does research alone confer credence as a leader in science and engineering? Are leaders college and university Deans? Prize winners for research excellence? Presidential Mentoring Award recipients? Members of the National Academy of Sciences or the National Academy of Engineering? Chairs of national committees? Members of policy boards such as the President's Committee of Advisors on Science and Technology or the

† For a select bibliography and data sources that speak to differences and similarities in preparation and participation in science and engineering, see Appendix A of this report.

National Science Board? Officers of professional societies? Directors of large research centers? The answer is all of the above and more.

In all of these cases, individuals have been elected or appointed to prestigious, visible positions that give them the opportunity to influence decisions and the flow of resources within or across institutions. Leaders are gatekeepers who shape opinions. Their sphere of influence may transcend disciplines and communities, span generations of students and professional peers, and give meaning to the terms "role model" and "mentor."

The Pool

From where do leaders come? What are their career paths? What are characteristics of the pool of potential leaders? There are at least two aspects to these questions. One is a matter of culture or climate: how do we nurture future leaders? The other recognizes the power of individual differences: some scientists, mathematicians, and engineers are more predisposed to becoming leaders – embodying the "right" qualities – than others.

Surely the interaction of the individual and the learning environment can promote or inhibit leadership. For this reason, it is important to focus on organizations as well as individuals when considering ways of stocking the pool. Indeed, some institutions excel at preparing leaders. Bowen and Bok's *The Shape of the River* is a ringing testament to the success of selective institutions of higher education in producing professionals – members of both majority and minority groups – who go on in their career to lead. However, those same institutions lose so many of the "precious few" science and engineering minority potential leaders to other fields that the success-story numbers are insubstantial. At the same time, minority-serving colleges and universities succeed in producing – at least at the undergraduate level – significant numbers of scientists and engineers. A nagging question remains: how well prepared are they to excel at the institutions from which leaders are sought?

The dimensionality of the problem is revealed by the pool of scientists and engineers available to advance through the academic ranks or up the corporate ladder. For the last 30 years, the annual number of baccalaureate, master's, and doctoral degrees awarded to U.S. minorities has remained a modest fraction of the total degrees conferred. The pool's minority composition is thus diminished long before opportunities for leadership appear. Instead, there is intense competition for the modest number of accomplished minority scientists and engineers by all sectors and organizations. The energy devoted to locating and wooing potential leaders must be seen as integral to *expanding* the pool, thus creating more potential candidates.

Put another way, with limited resources, is it better to increase the number of minority leaders in science, mathematics, and engineering by 5 percent or increase the overall pool by 20 percent? The former would emphasize strategies that impart skills and experiences to advanced graduate students and new Ph.D.s, even senior scientists and engineers who seek to compete for leadership positions. To increase participation, there is an array of programs, already operating through numerous partnerships across the U.S. to spur interest, recruitment, and retention in science, mathematics, and engineering. However, the Summit at Rice University was conceived as a forum for hard thinking on how to augment the considerable technical skills of a nearly-fully-formed scientist or engineer to enhance leadership qualities and expand the roles he/she could play.

The Event

While the Summit focused on leadership, the importance of representation, quality, quantity, and climate of participation in science and engineering education and careers was explicit. The purpose of the 1.5-day conversation among 60 faculty, federal agency, and other leaders was not to lament, document, or explain the problem of minority leadership.‡ Rather, it was, in the language of organizer Richard Tapia's invitation letter, "to develop an effective action plan to present to universities, industry, government, and

‡ For a list of participants, see Appendix B and for an evaluation of the meeting see Appendix C.

funding agencies that gives very specific suggestions on ways to develop critical national minority leadership."[§]

Speaking as individuals, excerpted below in unattributed quotes from the Summit's 187-page transcript, participants engaged in a dialogue. Topics ranged from broad issues such as academic practices, to more nuanced points about subcultural and individual differences that predispose some to risk-taking and others to risk–aversion.

Perhaps the personalities endowed with the former make some more likely than others to emerge as leaders. Should not risk-taking thus be encouraged and developed? But when does it become threatening to others and counter-productive? There are many correlates of cognitive and professional styles. Sex, race, and ethnicity may merely accentuate the differences and carry significant career repercussions. As one participant put it:

> What looks like confidence often in white male students and is rewarded as a young man who is kind of smart and cocky, in a woman is abrasive and in a minority male is arrogant.

One participant returned home and felt so passionate about the confidence issue that he wrote the following:

> Possibly the most important factor in the development of more outstanding minority scientists ready to attain positions of leadership is confidence. In conjunction with hard work, raw talent, and intelligence, it will overcome the possible deficiencies of a disadvantaged educational background. If you look at the leaders of today, the attribute that really stands out is confidence.

The most important outcome of the Summit, however, was a consensus for action *now*. Recommendations were offered on what needs to happen. This report elaborates in terms of who needs to assume leadership if minority scientists, mathematicians, and engineers are to increase their role in a variety of professional communities, in academe and out, now and throughout the 21st century.

[§] See Appendix D for Tapia's opening remarks, which offered a framework for the proceedings.

Focus of the Dialogue

The Summit provoked unusual candor about careers, institutions, professions, and cultures. We try to capture here the remarks that relate to various dimensions of leadership: academic practices, the role of information, career paths, why sponsors matter, and subcultural differences in "negotiating" social reality. All quoted material comes from the Summit participants. It represents recurrent themes around which the dialogue crystallized, prompting subsequent discussion of the possible actions reported in the section that follows.

Academic Practices. Many observers claim that the current academic culture tends to reward research and subordinate all else. Because institutions of higher education, especially research universities, are the chief knowledge production sites for the nation, this should not be surprising. However, as the competition for research funding has intensified, the culture has adapted by, depending on one's perspective, narrowing or entrenching the research role *at the expense of* teaching and service to the professional or local community. In short, there has been the embrace of a single "research" model by a range of institutions whose mission would suggest a broader commitment to education, outreach, and public service. The upshot is that human resource development, including the creation of future leaders, suffers: it is not explicitly recognized as a wise use of faculty time. Indeed, the extra time and effort required to mentor a minority student who is capable but unprepared is seldom rewarded. Accountability for "failures" – those who change majors or leave the institution altogether – is focused on the *student*, not the faculty or the administration. Losing the precious few is a failure that we cannot afford.

The Summit addressed the *academic practices* that serve to support certain members of the campus community – students and faculty alike – and not others:

> People who want to go into science enter [higher education] saying, "I want to go into science and mathematics," and they are so bowled over by the institutions that they end up leaving those fields. They may end up getting the degree in something else because they're good students but they didn't advance our cause. . . How do we hold those programs and institutions accountable?

At the same time, it is hard to ignore the role of *sponsors'* influence on the campus reward system:

> Put the money in places where you can't get it unless you agree to take on [a minority student] and if you don't you can't do any research. . . But if you aren't willing to make some major changes in the way we do business in terms of graduate education and research in America, you aren't going to solve this problem. . . .

> . . . leadership by presidents in graduate admissions? Graduate admissions is a cottage industry. . . run by departments and faculty who have different motives, different motivations – to get labor to support their research, pure and simple. Leadership by the federal government? Science is done today through the labor market of the research grant, be it an RO1 from NIH or an NSF award or a DOE grant.

> The agency culture and the professoriate culture are not distinct cultures, particularly within NSF. NSF is based on peer review process. Peer review means that you send the thing out the door, and it goes exactly to those people who are in the offices down the hall from me . . .

> Make it a requirement for federally funded academic research that the PI has to include a plan to address graduate and post-doctorate diversity issues within that PI's program. . . Also include a similar plan for the [PI's] own department and a letter from the university president supporting this.

Participants spoke at length about support mechanisms for students. Fellowships, traineeships, and research assistantships all offer financial subsidy. But each provides a different kind of experience because the locus of control changes from student, to department, to faculty PI, respectively. There is no optimal arrangement and like all human relationships, some faculty-student, mentor-apprentice relationships flourish while others fade. Again, accountability for outcomes was stressed at the Summit:

> Do we give the money to the student? Do we give the money to the institution? Do we give the money to the researcher? We either raise the floor for performance in those places or we shut them down. . . Either they get better or they get shut down. The role of policymakers within universities, particularly boards of trustees, has to force some accountability to help put the appropriate pressure on our president and administration. . .

> . . . training grants should be vertically integrated, that is, there should be support for students starting at the undergraduate level through graduate training and to the post-doctoral level, and this can be done within as well as between institutions. . . One of the benefits of this kind of a program is that you can create what we termed a "learning community." The second is the idea of establishing a national postdoctoral training program for minority students . . . these fellowships would be given to departments as opposed to individuals and to those departments that have

a track record for placing fellows at top research institutions as faculty members.

Career Paths. The result of innovations in accountability is that faculty and students, as well as the institutions that employ and educate them, adopt a proactive posture toward career development, skills, and the information to make choices on paths to pursue. Summit participants noted that:

> . . . it's not unusual to find a lot of underrepresented minority Ph.D.s who had an undergraduate experience either at . . . a historically black college or university, a minority-serving institution or a community college.

> . . . criteria for determining merit never include track record of producing persons of color with doctorate degrees. People like _____ are "boutiques" at many of our institutions. The question is how do you make this systemic?

> The things that produce excellence do not necessarily grow out of these institutional programs. So, we've got to find a way to support those activities that build excellence, that build confidence.

> . . . students have to know a lot about what the possibilities are, what the options might be and be able to make very conscious choices, real choices about what they're doing. But we talked about tapping the experiences. How does one make the best use of those sorts of experiences to craft programs that are going to be useful for what they do with their emerging leaders?

A common denominator in these remarks is information – how much do we have, what do we lack, how do we share in a timely way what is known with the people who need it? This is not a research issue, but a dissemination and technical assistance need. There is also a dimension to data, however, as framing reality in unhelpful or misleading ways:

> And there is no information that is being collected right now to show that in a systematic way that there are different outcomes to different groups depending on how they're being supported.

The speaker both overstates and understates the case. Data are collected, but the categories can mask what decisionmakers need to know. The 2000 Census form invites respondents to check off all categories of ethnicity as opposed to selecting one, as has been done in preceding surveys. The opportunity to declare one's "multicultural" identity should be revealing. Statistically, the numbers will be small. But symbolically they may speak volumes.

For example, the category "Hispanic" or "Latino" includes such a diversity of groups – Puerto Ricans, Mexican Americans, Cubans, Central Americans, etc. – that the subcultural differences among them overshadow their grouping under a single designation. Put another way, diversity can mask the extent of underrepresentation. Historically, their educational experiences and achievements also diverge, so clearly there is a need to *disaggregate further* and become sensitive to what's in a definition and how does that translate into expectations and opportunities – decisions about admissions, qualification for support, prediction of probability of degree completion, etc.

The on-site implications of such information are formidable:

> There are mentoring programs in industry. We don't have mentoring programs for the junior faculty to show them how they should be preparing for leadership or how to act in a professional manner.

As one Summit participant noted, "professors need professional development, just as teachers need professional development." These faculty mentoring programs would have to be university-specific. How one succeeds at a university depends on the culture and traditions of that particular institution and may not bring success at another.

The kind of faculty *professional development* needed is not the typical sensitivity training and sexual harassment seminars that become a legal exercise disconnected from academic culture. Rather, it is imperative to instruct faculty on the compatibility of human resource development with recognizing the subcultural differences that students bring into the classroom, on gender differences in classroom participation, on learning styles, and on the difference between faculty advising (with a specific narrow band of concerns) as opposed to mentoring (supporting a student's broad range of needs, answering questions unrelated to academics per se, extending networks to model future professional behavior, in general, being a good listener and counselor). Above all, reminding all members of the campus community that diversity is a strength and all, regardless of academic credentials or age, have areas for continuous improvement, knowledge, and skills acquisition.

Making Leaders. The problem of minority leadership in science, mathematics, and engineering is embedded in cultural milieux that will not change overnight. Indeed, today's academic culture is a microcosm of currents in American culture. Changing it demands realism: culture is stodgy, conservative, reliable, and predictable. Efforts at inclusion represent disruptions and require adaptations of "the way things are done." Humans resist such change as uncomfortable; often we question the need.

In the year 2000, with demographic projections in hand, the need for change toward growing segments of the U.S. population is no longer arguable. *How* to change is. That is why leadership is such a critical commodity. In the words of a Summit participant: "The places that I've seen where we make a difference is when we actually get into power and positions of making decisions." Elaborating, another explains, "If we understand ourselves best, then we should speak for ourselves and not continue to have those who study us speak for us. In this way we can impact change and national policy first-hand."

To become positioned for recruitment to leadership in an academic career, one needs to climb the academic ladder – complete the Ph.D., get hired based on early publications and recommendations (if one does not enter the professoriate, one cannot exhibit the qualities and acquire the experience antecedent to leadership status), distinguish oneself as a productive faculty researcher to secure tenure, be promoted to full professor and assume local administrative responsibilities while sustaining an active research program that is (inter)nationally respected. Others added:

> We just need a handful, right? A very small fraction of any group becomes the leaders. It would be a much more focused approach, a much more cost effective approach, if we would focus on those places that are doing reasonably well and make them better than to focus on the places that are really doing badly.
>
> Who will become the next chairs and deans of your departments in terms of that kind of leadership? First, you need the credibility of tenure, of senior stature, of accomplishment in research before movement to the administrative rungs of the academic ladder is within reach.
>
> We should look at four kinds of leadership that we need to make happen. There's the academic and research level, which is what most people have been talking about here, which is necessary. Leadership in academic management because

> they make the difference in what the culture of the institution is. Leadership in government and policymaking. Those will make changes. And one we shouldn't forget is leadership in K-12 education because universities do have a role there. If we keep our eyes fixed on those four . . . borrowing again the phrase a "thousand flowers blooming," you will get a few leaders.
>
> Minorities serve on thousands of committees, but they seldom are asked to chair them. It's as if they are afraid that we will either run away with it or do nothing. We are perceived as being either too passive or too one-dimensionally aggressive to lead.

The path to leadership in the corporate sector, in a large company or as head of a small high-tech venture, is no doubt different from policy leadership in or outside of government. If one subscribes to the approach that a common core of skills and characteristics distinguishes effective leaders, then sector and type of organization should be a lesser concern than providing a training ground for leadership that evolves as careers unfold.

NSF's Singular Role. The National Science Foundation has been pivotal among federal agencies in supporting the participation of U.S. minorities in science and engineering. The agency's programs fund many of the institutions represented at the Summit. And with that funding come expectations that NSF can, and must, do more to fulfill its congressional mandate in human resource development.[**]

> NSF is an appropriate audience for the report [because] . . . it should be able to leverage its own ideas, its own sources to help build the connection with the public and private sectors.
>
> There is continuity in a continuum of support and interest, and coherence across the continuum . . . NSF already supports programs in the K through 12 arena. It supports programs at the undergraduate level, at the graduate level, at the postdoctoral level, the faculty level, yet one does not necessarily see the connection among those activities. . .
>
> We must help to diversify NSF. A lot of us senior faculty have to say "Yes, we will spend a year at NSF and if you give us an appropriate position, we can actually make a difference."

[**] NSF's 1980 reauthorization, modified but still in force, directs the agency – uniquely – to increase participation of women and minorities, and now persons with disabilities as well, in science and engineering.

> This body can declare that the system is broken . . . You want to know what federal agencies do with [rotators and visiting scientists] and you want the entire program to be restructured so that minorities . . . can participate at an equal level.

The capstone of the NSF suite of programs would be one directed to leadership beyond formal education. Professional development of leadership would be a kind of training that augments skills and adds capability to an already-productive scientist or engineer. Leadership skills are often considered "non-technical," i.e., interpersonal, communicative, charismatic, and highly idiosyncratic. Nevertheless, although some have more natural propensity for it, leaders are made, not born.

Proposed Actions

Like many innovations developed at a single site and motivated by the needs of a particular population, the creative challenge is "scaling up" or transferring what works to new sites and populations. In short, improving the prospects for minority student ascendance to positions of leadership depends on identifying practices that "travel." Once they take root, even as "experiments," they heighten the likelihood that they can be institutionalized. By this we mean, they become self-supporting by the host organization *after* the funding by the original outside sponsors has expired. Institutionalization means that the local institution has claimed ownership, making the program goal part of its culture and devoting human and fiscal resources to its ongoing attainment.

Formulating strategies for acting on this organizational imperative was the ultimate goal of the Summit. This is what emerged.

Institute for Leadership

> . . . create a national leadership academy and it would have perhaps three components – a fellows program, a site program and a research and evaluation program.

> The fellows program would be modeled on some combination of the kinds of programs out there – AAAS, Congressional Fellows, White House Fellows, where people put in applications for what it is that they want to do. And it might be a postdoc. It could, in fact, be a graduate student. It might be an assistant

professor. It could be somebody coming back from industry into the academy.

A national leadership institute would be a resource for all involved, or seeking greater involvement in, the development of minority scientists and engineers. It would represent a learning community of senior and neophyte professionals. Organizations with a portfolio dedicated to the next generation of scientists and engineers, such as the Alfred P. Sloan Foundation and the Research Corporation (Tucson, AZ) would lead a list of prospective sponsors.

The Institute would ideally be "plural" – distributed at various sites where research universities, in collaboration with corporate partners, pursue knowledge production and application. Institutions that host NSF-funded Science and Technology Centers, Engineering Education Coalition, collaboratories, and Louis Stokes Alliances for Minority Participation (LSAMP) projects would represent the kind of setting, with the mingling of human and fiscal resources, for nurturing leadership through research, product development, and management of staff and projects. Such a context cannot be invented or simulated. It must be present to allow opportunity for growth in creative environments. Examples already exist of research institutions with track records in granting science and engineering Ph.D.s to U.S. minorities *and* strong global industrial partnerships. They should be built upon.

The Institute's operational components at each site would be, in skeletal form, as follows:

Fellows Program. A Fellowship program would provide leadership training, on a competitive basis for a finite period, at the graduate, postdoctoral, or young professional stages of the career. It would model leadership behavior. The experience, in a research-intensive setting, would emphasize as a mainstream obligation the development of talent in the workplace. Technical skills are thus seen as a minimum requirement, not complete fulfillment of expectations. A senior internship program would pair minority full professors and their industry analogues with established science and engineering leaders in research and education settings. All of these would be expensive, but selective,

alternatives for developing leaders – influential people who cross boundaries, synthesize ideas, galvanize constituencies, and make a difference.

On-site Academy. A second function of an Institute would be the professional development of Ph.D.s as mentors and members of important networks. Leaders communicate informally and act as gatekeepers for exchanging information about people, trends, and opportunities. Offices on campus, such as Harvard's Derek Bok Center that offers faculty tutelage and feedback on teaching and learning techniques, can serve as models for incubating innovations without the risk of reprisal, i.e., the tone is positive and the message sent by the institution is its positive valuation of the activity.

Studies Program. To assist innovators and skeptics alike, while increasing the credibility of human resource efforts through evaluation, the Institute would support a studies program for visiting scholars. Their collective goal would be the development of criteria that capture the characteristics of programs and activities that succeed in cultivating leadership among minority populations in the context of science or engineering workplaces. Federal agencies should be especially committed to funding such studies.

Coalition of Minority S&T Associations

The matchmaking of qualified minority baccalaureate recipients with quality science, mathematics, and engineering programs is a continuing struggle. SACNAS and the National Society of Black Engineers perform yeoman's service for their constituencies. But until the American Chemical Society and FASEB, just to name two large professional associations, make the "minority issue" *their* issue, minority students and faculty will be excluded from important conversations and marginalized within their disciplines. Academic institutions with world-class faculty and research facilities are the necessary sites of advanced education and training for the next generation of minority, as well as majority, scientists and engineers. From among these ranks, in these settings of international repute, will emerge the next generation of leaders.

Nonprofit organizations such as the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM) have advanced the cause of matchmaking for a quarter-century. This pool formation and credentialing - labor-intensive to be sure, underscores how the lack of information on who is qualified but invisible precludes "connections" for mutual benefit. Today, of course, information technology can be creatively and fruitfully employed. But the fact remains that leaders are a small subset of this pool. Without preparation for global technology-rich opportunities, minority scientists and engineers cannot compete for the leadership positions of the 21st century.

Registry of Minority Undergraduate Students. This might be a compilation of various lists that academic and corporate recruiters could easily consult. Providing hot link to web sites would create a directory that facilitates "matchmaking" a la GEM. An NSF source is the LSAMP program, which offers a model of institutional coalitions – many involving collaboration among minority-serving and majority institutions – targeted to the production of minority baccalaureates in science, mathematics, engineering, and technology. A third model that incorporates career advice and first-person experiences with notices of employment and advanced degree opportunities is AAAS's NextWave <www.nextwave.sciencemag.org>.[††]

Kiosks and Catalogs. There is something to say for old-fashioned media – the hard copy and the face-to-face communication. These networking tools should not be abandoned. Indeed, it may be better to think about technology as augmenting these interpersonal means of conveying information, correcting impressions, and connecting people who otherwise would be ignorant of one another's efforts and organizations. Conferences, symposia, and workshops that expose students to working scientists and engineers *who are leaders and role models.* This affords students – through exhibit booths, poster sessions, and panel discussions – the opportunity to present their work, receive constructive criticism, and build their own professional network, all of which are essential for future leadership.

[††] A starter list of Web Resources is contained in Appendix E.

A Federal Diversity Coordinator

> The major system for accountability in federal agencies is now GPRA [the Government Performance and Results Act of 1993]. Every agency has to say what its goals are and measure its audit performance against them. I think it would be a very powerful move to make sure that every agency has in its GPRA plan the kind of goals and changes that we are looking for.
>
> The diversity "czar" would cooperate with audits of agencies on this issue. There would be something like the office of federal contract compliance and programs that would oversee an audit of a federally-funded organization and how well they're performing on diversity issues.

A federal Diversity Coordinator could be appointed by the President as Deputy to the Science Advisor. The Deputy would monitor what the Federal agencies are already directed to do – replenish a workforce dedicated to advancing the agency's mission. The R&D agencies sponsor programs that help to create future leaders by intensifying activities that support participation in science, mathematics, and engineering. Bolstered by GPRA performance plans and reports on degree-taking in science and engineering, the agencies are already accountable for achieving certain human resource goals. Such an appointment would "raise the stakes," the visibility, and the priority of building the pool of potential science and technology-based leaders.

The R&D agencies would be expected to link their research programs more explicitly to their strategic plans and GPRA reporting. Locating the Diversity Deputy in the White House Office of Science and Technology Policy would ensure a different kind of accountability and treatment of the issues discussed in this report.⁂ The Deputy would have a continuing responsibility to consult with agencies on the application of their research award criteria to make increased recruitment, retention, and degree-conferral an avowed goal of agency funding.

⁂ OSTP recently issued its own report pertinent to these issues: National Science and Technology Council, *Ensuring A Strong U.S. Scientific, Technical, and Engineering Workforce in the 21st Century*, April 2000. http://www.whitehouse.gov/media/pdf/workforcerpt.pdf

Invoking nothing less than the moral suasion of the Executive Office of the President, in conjunction with congressional oversight and special bodies such as the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development,[§§] will keep minority participation and leadership clearly on the federal radar screen. Complementary efforts by professional societies and especially activities such as the National Academy of Engineering's Committee/Forum on Diversity will etch the issue on the national economic and workforce agenda. It is easier to monitor outcomes once the nation's attention has been riveted by the leadership of the political system, as well as the research and policy communities.

Disseminating This Report

All organizations that represent career opportunities and compete as employers for talent – Federal, corporate, foundations, and other nonprofits (such as community-based organizations) – are potential partners in transforming the proposed actions into realities. A report of an event is a mobilizing force. It stirs emotions and triggers ideas. It should inspire, but how it is interpreted and acted upon is the ultimate test of inspiration: are people moved to act, or act differently? Do they see themselves as part of the implementation of a program or a previously ad hoc effort? Do they take ownership?

It is our hope that readers will share this report with colleagues, send it with a cover letter to anyone who cares or should care about the issues addressed. Be inclusive. Urge comments and reactions by professional communities in their journals and newsletters. "Make news" of representation, participation, and leadership in science and engineering.

[§§] See *Land of Plenty, Diversity as America's Competitive Edge in Science, Engineering and Technology*. Summary of the Report of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Development, July 2000. http://www.nsf.gov/od/cawmset/

Conclusions

Leadership of, by, and for science and engineering is a national issue. It is an increasing challenge in a technological society with a largely technologically-illiterate citizenry. Leaders must bridge that gap. They must be and do what most cannot or will not attempt.

The participation of U.S. minorities in American life is part of everyone's "American dream." However, the nation must help the next generation realize that dream, drawing on the resources of our local institutions and the power of our convictions. We must count on one another and overcome the fear of "Change is good. You go first" to "Change is good. We can do it together – for our children and our future."

Appendix A

Selected Bibliography
And
Data Sources

Bibliography and Data Sources

Bibliography

American Association for the Advancement of Science. (2000). Science next wave global home.
Available: http://www.nextwave.sciencemag.org

Bowen, W. G. & Bok, D. (1998). The Shape of the river: Long-term consequences of considering race in college and university admissions (pp. 106-110). Princeton, NJ: Princeton University Press.

Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology, September 2000.
Available: http://www.nsf.gov/od/cawmset/

Commission on Professionals in Science and Technology. (1998). Employment of Recent Doctoral Graduates: Results of Professional Society Surveys. Washington, DC: Commission on Professionals in Science and Technology.

Malcom, S.M. 1999. "Fault Lines." Science 284 (May 21): 127.

National Action Council for Minorities in Engineering.
Available: http://www.nacme.org/

National Science and Technology Council from the White House. (2000, April 11). Ensuring a strong U.S. scientific, technical, and engineering workforce in the 21st Century.
Available: http://www.whitehouse.gov/media/pdf/workforcerpt.pdf

National Science Board. (2000). Science & engineering indicators - 2000. Arlington, VA: National Science Foundation, (NSB 00-1).
Available: http://www.nsf.gov/sbe/srs/seind00/access/c2/c2s3.htm#c2s3l6

National Science Foundation. (1996). Women, minorities, and persons with disabilities in science and engineering: 1996. NSF 96-311.
Available: http://www.nsf.gov/sbe/srs/nsf96311/start.htm

_____. (1999). Women, minorities, and persons with disabilities in science and engineering: 1998. NSF 99-338. [On-line].
Available: http://www.nsf.gov/sbe/srs/nsf99338/frames.htm

Nerad, M. and J. Cerny. (1999, September 3). "Postdoctoral patterns, career advancement and problems, from the PhDs-ten years later study." Science.
Available:
http://www.sciencemag.org/cgi/content/full/285/5433/1533?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&titleabstract=Postdoctoral+Patterns&searchid=QID_NOT_SET&FIRST
INDEX=

Data Sources

National Science Board. (2000). U.S. and international research and development: Funds and alliances. (NSB 00-1). Available:
http://www.nsf.gov/sbe/srs/seind00/access/c2/c2s3.htm#c2s3l6

_____. (2000). Completion and attrition rates five years after beginning an S&E major, by race/ethnicity and sex. (NSB 00-1).
Available: http://www.nsf.gov/sbe/srs/seind00/c4/fig04-26.htm

_____. (2000). Earned associate's degrees, by field and race/ethnicity: 1977-96 (selected years). (NSB 00-1) [On-line].
Available: http://www.nsf.gov/sbe/srs/seind00/append/c4/at04-34.xls

_____. (2000). Bachelor's degrees in S&E fields earned by selected groups. (NSB 00-1).
Available: http://www.nsf.gov/sbe/srs/seind00/c4/fig04-28.htm

_____. (2000). Master's degrees in S&E fields earned by selected groups. (NSB 00-1).
Available: http://www.nsf.gov/sbe/srs/seind00/c4/fig04-30.htm

_____. (2000). Doctoral degrees in S&E fields earned by selected groups.
(NSB 00-1).
Available: http://www.nsf.gov/sbe/srs/seind00/c4/fig04-32.htm

_____. (2000). Index of growth in full-time doctoral science and engineering faculty, by rank and race/ethnicity: 1973-97. (NSB 00-1).
Available: http://www.nsf.gov/sbe/srs/seind00/c6/fig06-15.htm

National Science Foundation. (1999, December 15). Graduate enrollment in science and engineering continued to decline in 1998. Data Brief (NSF 00-307).
Available: http://www.nsf.gov/sbe/srs/databrf/db00307.htm

Appendix B

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Appendix C

Meeting Evaluation

RICE

Meeting Evaluation

Forty-one out of 58 (71%) participants returned evaluation forms at the end of the meeting. Attendees were asked the following:

> The goal of this conference was to identify directions the nation should take to foster and empower potential minority leaders in science and engineering and to draft guidelines that universities, industry, government and funding agencies can embrace and implement.
>
> Please rate the conference as to its effectiveness in meeting its goal on a scale of 1 (Poor) to 5 (Excellent).

Eighteen (44% of those responding) answered "5", 21 (51% of those responding) gave the conference a "4" and 2 people (5% of those responding) answered "3".

Additional comments and suggestions were requested and all that were submitted follow:

- Good discussions, difficult solutions.
- The conference was very effective in identifying directions and strategies to foster potential minority leaders in science and engineering. I am hopeful that the guidelines draft will be used by public and private sector institutions to foster the goal identified above. Perhaps more time could have been devoted to collaborative efforts in small groups. In spite of the short time spent at the meeting, much was produced to be incorporated in draft guidelines. The meeting was also important in bringing all of the "players" to the table and in raising the consciousness of all participating in the Summit. Many thanks to Richard Tapia for leading this effort!
- The premises as laid out were useful. There was not enough time in break out groups to formulate specific recommendations.
- If I had been able to stay longer on Tuesday, I'm sure I would have been better able to say whether it was more a 4 or a 5.
- The organization was excellent. The participants represent a good cross-section of the minority community, but all were not able to give uniform ideas on how to move forward.
- There didn't seem to be enough time to develop real consensus around a prioritized set of strategies.

- Breakout groups needed to be longer to develop more recommendations and more thoroughly thought out recommendations.

- Opening comments of Malcom and Tapia were interesting and valuable. Would have been useful to have more specific shape to the breakout groups.

- Not enough time! Too rushed to cover the volume of work required. Otherwise a good program. Excellent entertainment!!

- I would have appreciated more pre-meeting materials and preparation, so I could have hit the ground running in the discussions. For a one-day event, it takes time to get the intellectual juices flowing, particularly when one has so many different balls in the air.

- The conference was most certainly a success in terms of bringing leaders together for face to face dialogue and brainstorming on the issue. In retrospect though, I feel as if the focus was heavy on graduate school scholarships, entrance requirements and university president cooperation and lean on questions surrounding getting students to a position where they may be eligible and motivated to apply to graduate school.

- A conference of this magnitude a scope requires more time. It would also benefit from a more remote, isolated locale.

- Not enough attention paid to "legal obstacles" faced by public universities in fostering diversity by race and gender neutral means. While sincerity and focus of group was evident, some direction/guidance re: legal concerns is needed to guide this discussion of solutions to the "problem".

- This was a very valuable meeting. I thought the format and topics covered were excellent, as well we the thoughtful participation of many individuals.

- The conference was very well organized and it covered the areas that it aimed to cover. More time was required to explore and suggest "guidelines" to develop stronger minority leadership. I am looking forward to the report that will be sent to all the participants and defining an action plan! P.S. Thank you for including several young leaders.

- Thank you very much for letting me participate in this conference, it was a great learning experience for me. I was not aware of the magnitude of the problem and the need of minority leaders which is true after seeing all of you as role models, one gets a bigger compromise toward the community and especially the Hispanic community in my personal case. I feel very thankful that I will have a chance to work in an 85% Hispanic population

community, and will definitely want to keep involved in these kind of experiences to further promote minority leaders in science and engineering. Thanks again and if I can be of any help in further events or situations please contact me.

- A key concept that came up in our small group meetings (with great emphasis) and also in the large meeting was: success in this arena comes from key individuals, individuals who are devoted to those goals, within our institutions. Hence we should look for these individuals and continue to find them and hence their institutions. To do otherwise has not been as successful and we have many examples to show for this!

- Richard- Like the Sloan meeting. This was dynamic and exciting, and a great opportunity to hear from leaders of diversity programs, and I thank you. Most critical to me is the follow up. What will happen with the report? For example, I don't recall any follow up after the Sloan meeting, other than the establishment of the email reflector (I'd be happy to add the people from today's meeting to that reflector) & the communication we've seen through that. So-will there be a report? What will become of it? Will it have teeth?

- I enjoyed the discussions and suggestions and am glad (honored) to have been included. Thank you for pulling this group together and thanks to your entire staff (everyone has been so friendly and hospitable). We are perhaps visiting issues that have been kicked around for too long, but they must be wrestled with in order to see demonstrable change in the leadership of minority scholars in science & engineering. I am willing to work on our next step.

- Very "enriching" & stimulating. A badly-needed, forward-looking issue being seriously engaged.

- I would have appreciated more dialogue in smaller groups.

- Richard, keep up the good work. I will be more than happy to help in any future endeavors in this direction.

- The interaction was good, but it is not clear what the outcome will be-the report should clarify this. One problem was that there was no general agreement on what is "developing leadership." To some of us (like me) it necessarily takes on an elitist stance which is not a popular idea with others. But I think the discussion helped in bridging gaps.

- I suggest that an executive committee be formed to formulate a report.

Appendix D

Framework: "Lack of Minority Leadership:
Possible Causes and Plausible Solutions,"
by Richard Tapia, Rice University

Lack of Minority Leadership: Possible Causes and Plausible Solutions
Richard Tapia

Introduction

We are here today to address a serious problem. The National Science Foundation has sponsored this summit meeting we are calling *Promoting National Minority Leadership in Science and Engineering*. We are happy that you have accepted our invitation to come. You are vital to the meeting's success. Our success will require people with the vision, determination, and clout to create and promote an effective plan that universities, industry, government and funding agencies will embrace and implement. We are not here just, once again, to lament the past. Through our discussions, we must formulate the beginnings of a plan that can advise policymakers.

Despite a generation of intense efforts, the nation continues to face the dilemma of perilously low minority representation in Science and Engineering. Even more troubling and threatening to future success is the lack of the next generation's minority national leadership. Who will replace the critically few senior minority leaders if we do not identify, nurture, and guide potential leaders into places of authority?

When I look around the room, I see examples of prominent national leaders who happen to be underrepresented minorities. I see senior faculty at important research institutions, leaders of national professional societies, industry leaders, university presidents and senior administrators, and managers of national laboratories. You are the existence proof that underrepresented minorities can be leaders. It would be good to ask all of you what factors you credit for your success -- how you got where you are today. We should ask the question -- what worked for us -- to see if those lessons learned can be applied to create many more of us.

In that vein, let me talk about my own personal experience and what helped me to become a leader. It was never in my design to be a leader. In fact, I grew up quite shy and quiet. I was not a star student in high school. I loved mathematics, but I also loved cars, and did not strive to be an academic star. No counselor or teacher ever advised me to go to college, so I went to work right after high school at a muffler factory. An older co-worker convinced me not to make the same mistake that he had made as a young person, that I was too smart to do what I was doing, and that I should go to college. I enrolled in community college, did very well, transferred to UCLA, and ultimately got a Ph.D. there.

If you ask me how my leadership evolved from those humble beginnings, I would say that one of the best things that ever happened to me was to go to the Army Mathematics Research Center at the University of Wisconsin, one of the premier research institutions at that time. I met some of the finest mathematicians in the world, and also caring people who actually talked to me. I attended lectures, learned how to ask questions, and started to become more forward, more outspoken, and less shy. I co-authored papers with some of the finest mathematicians in the world. When I left that

center, people knew me; I had established a network of important mathematicians that gave me a strong base for leadership *in my field* that exists even until today. Let me explicitly make the point so that nobody misses it -- I was given an incredible opportunity, and I took full advantage of it.

Today we will be talking about those two things -- institutions and individuals -- what institutions need to do to promote minority leadership and what individuals need to do to promote themselves as leaders.

What Institutions Must Do

We must face the fact that the quality of a person's institution is in large part going to determine how well positioned a person is to fulfill their leadership potential. If MIT, Stanford, Caltech, UC-Berkeley are producing leaders in terms of national organizations and professional societies, then we must have representation in these places, because the culture is such that you can't come in the back door. It is very hard to come in from the school that is not part of the network. You could say that's not fair. I agree, it's not fair, but that's the way it is, and trying to change that would be much harder, in my opinion, than changing the representation issue. Bowen and Bok, in *The Shape of the River*, argue that underrepresented minorities going to selective schools do turn out to be leaders, in fact, become leaders in proportions greater than the majority.

Let's just tell it like it is, shall we? A Ph.D. from Caltech, Princeton, or Stanford is going to have several points up over a Ph.D. from a less esteemed majority or minority serving institution. We do the leadership issue a disservice if we treat this fact as an ugly little secret that can't be talked about. We must face it and deal with it. Given this fact, shouldn't we strive to get more underrepresented students into more prestigious schools and then hold the institutions accountable for nurturing and preparing those students? I challenge these institutions: what leading university will step forward and distinguish itself with an innovative program to triple or quadruple its Ph.D. underrepresented minority production?

There are underrepresented minority students who have had first-rate educations who look like majority students, and in every way are as capable and as sophisticated. It really isn't an issue if they go to Stanford, Berkeley, Caltech, or Cornell. They're going to do well. But that's not the bulk of the underrepresented minority population. And for schools that say, "we're going to fight for that first pool", I ask, what are you contributing to the nation's representation with that tactic? If you fight for members of the first pool by offering more money or more perks, you really haven't done anything to address the issue of underrepresentation. You've made your school look better. You can say "oh, look we're leading the nation, or whatever you want to say, but what have you done for the global pool, what have you done for the underrepresentation crisis? You haven't done anything.

Instead of just fighting over the best students, I would like to ask that we identify and support the "second pool", the diamonds-in-the-rough that don't look like traditional candidates. Of course, I have biases here, because I myself was a part of the second pool,

and because I've had success with students from the second pool at Rice. By second pool, we do not mean second class. The second pool consists of individuals who are certainly talented and capable, and can succeed given proper guidance, but who either have not been properly developed or properly evaluated. It is this second pool that we are losing. They take special effort. They require mentoring, guiding, and sometimes remediation. They may make a slower start. In our department, we have mostly the second pool, and we produce quality graduates. Our second-pool minority students have been combined with first-pool traditional students, and to our credit we have learned how to make it work. After one or two years, our second-pool students often are viewed as comparable to anyone in the department. So Rice has shown that what we propose -- looking more at second pool -- can be done successfully.

I'd like to say again that I came from this second pool, so I have some particular sensitivity here. I frequently tell our Graduate Admissions committee when I'm arguing for a certain minority student applicant, that they would not have accepted me based on the traditional criteria that they are applying. Our department is not that different from others. If we had gotten the quality of traditional applicants that Stanford gets, the faculty would have been extremely happy, we would have accepted them, and it would have been impossible to get a second-pool minority student accepted. But we didn't, so we accepted students who didn't have all A's necessarily or who had low board scores, but who had faculty saying this person is a very creative person. We have case after case of success under these parameters. Now we challenge other selective schools to do what Rice did.

Of course, if we look to this second pool, then we most likely will have to do more to help students overcome some lack of preparation. Retention activities are always important, but they are absolutely critical with this group. These students may face what I call the "moment of truth". This is a time when you change comfort levels. You go from a situation where you have been quite comfortable to one where you are uncomfortable. For an African American student it could be moving from a school that was predominantly African American to a school that is predominantly majority. It could be a change that occurs at first grade, middle or high school, college, graduate school, faculty, at a job, or even at a high-level leadership position. At Rice, it frequently happens to students who have come from minority schools. The main problem they're dealing with is feeling isolated and alone in an unfamiliar and seemingly unfriendly environment. The academic problems may or may not be present, but certainly the students are dominated by a drastic change in environment. A support group of caring individuals -- some peer, some faculty -- must intervene to smooth the transition and reduce the possibility of losing individuals at these critical junctures.

Universities must do more to support these activities as part of their mission. Retention activities must become much more a formal part of the reward system throughout all levels of the university -- undergraduate through tenure. To be successful, programs must be integrated into departments and not relegated to "minority land" led solely by staff. The scientific community is elitist about this activity as well. They will not respect it if it is not led by faculty members who understand faculty culture. At Rice,

we have been quite successful with a model of faculty leading our retention programs with extensive staff support. Universities should also reward faculty for their participation in these very time-intensive activities. It must become a formal part of the university reward system if we are to change the culture.

I'd like to ask that we hold presidents accountabie for mandating change. Presidents talk a good game, but they must go down to the level of the dean and the chairs and say, "Look, this is a part of the mission and you must play a role in this. You will be held accountable. In turn, success in these areas will be reflected in the reward system." We must align the reward system with this mission. I have seen far too many times individuals who buy into the mission, work really hard with students (which costs them something, in terms of research productivity), then suffer at the time of promotion or at a time of tenure, because while the university said this was of value, it wasn't valued enough to be a part of the evaluation process.

I believe departments should be the unit of accountability. I don't believe all individuals should be the same. I think some faculty members are very good at certain things and others at other things, but I think a department is a sufficiently large unit to say it's good or bad at supporting our mission. It's done a good job of bringing in nontraditional students, nurturing them and educating them well. When departments are faced with this, however, they will say, "But how do we stay in the 'Top 10' and still do this?" I say, the accountability system should be such that you can't get in the Top 10 if you *don't*. We must make representation a criterion in judging how well departments are doing.

We must deal with the risk-averse problem in faculty hiring. Departments must say "We are being held accountable for more than just research. Look, this person is a good researcher but he will also give us many dimensions that we have never had." When I was hired, I was not the first choice. I know that. The first choice went on to a very undistinguished career. I was hired as a second choice. But I don't think I was evaluated with the expectation that I'd bring dimensions of teaching, of nurturing, of mentoring, of research, of national visibility. And yet, I can honestly say that I didn't doubt that I would do all those things even though those doing the hiring were not able to predict that.

As we move up through the selection ranks -- undergraduate admissions, graduate admissions, then departmental hiring -- selection becomes more and more traditional. By far, departmental hiring is the most traditional. I think most individuals in a department want to replicate themselves. I am good; therefore good people will look just like me. The department itself is extremely risk averse when a candidate looks a little different, and this surely includes underrepresented minorities. The dimensions in which they can contribute seem not to be evaluated at hiring time. In all, I believe that departmental hiring is perhaps the most problematic of all the admissions, if you will allow me to call it "admissions".

One difficulty that I have encountered with my own minority students is placing them after graduation in positions where they will be challenged. I think that they have

started to reach their potential, they're ready to go, but they can't get the experience, the post doc experience, the faculty experience at a university that would be challenging to them, and yet I believe that they would be competitive there. They just need an entrée; they just need a way to get there, they need a similar opportunity to what I had at the University of Wisconsin. Perhaps what we need is a national high-level intern program where students are placed with leaders in their field. They would bring with them full funding and the research director would be charged with guaranteeing that the student is fully integrated into the research group. Funding agencies like NSF could make a real difference with such a program.

What Individuals Must Do

Building a solid research career is the first essential to leadership in science. Throughout my career, it has been important to me to be recognized as a mathematician who happened to be a minority. I realized that I would be evaluated on my research credentials. The scientific community is elitist about this topic. They will not respect or promote the professional minority who does not have those credentials. I don't want to be a professional minority who happens to be a mathematician. I want to be a mathematician who happens to be a minority.

Because of this, I counsel students to get tenure first before they start doing outreach. Build your career as a scientist first, and then you will have a strong foundation on which to give to others.

Yet I find minority graduate students choosing the "comfortable" advisors. They tend to avoid the aggressive advisor or the aggressive research group. Their choice often will be a junior, non-tenured faculty member, or maybe a minority faculty member, and that's often not the best choice. This creates a double whammy for minority leadership. It puts too much burden on the young minority faculty member who is really trying to get tenure or go forward, and it doesn't position the student to establish a strong network. I believe these are things that can be dealt with through proper mentoring and advising. I've had numerous minority students at Rice who have said, "Oh no, I could never work with that person." But they did, and it was a wonderful experience.

Individuals must be bold in their *self*-development and *self*-promotion if they are to attain national leadership positions. Some minority students are bold and daring by nature or through positive experiences with risk-taking. As we all recognize however, the majority of underrepresented minority students are not. I have found in my work here at Rice that underrepresented minorities frequently shy away from self-promotion and are highly averse to risk-taking. Or sometimes they just don't know how to navigate the waters of the scientific-research world, making mentoring so essential to these students. A fundamental theorem of mentoring underrepresented minorities is this: assume students don't know what they should do and that they need your advice. A hands-off approach in mentoring underrepresented minorities just doesn't work. Oftentimes, I play the role of a caring father when the students that I mentor need correction or advice. If you must err, err on the side of too much rather than too little intervention. I have had

students tell me -- we didn't know we needed mentoring; we didn't want mentoring, but now we realize that it was of great value.

Networking is absolutely critical to leadership, yet networking requires the boldness that we are talking about. It is highly unlikely that one can build a strong network through timidity. Professional development in networking is essential for underrepresented minorities. When you take minority students to conferences, *require* them to look for opportunities to network. Don't assume that they will just naturally do this. *Insist* that they ask questions of speakers in their area. Introduce them to your network of colleagues and include them in both social and professional situations. Also insist that they attend colloquia when they are at home and get to know the faculty in their department. That way they can become a part of their network as well. We all walk a tightrope of being too pushy and aggressive or too timid and passive, but if the student or young faculty member shows a genuine interest in the science, that will be valued by the senior person. Otherwise it will come across as self-promotion for its own sake.

Let your students know that *you* sometimes volunteer to give talks, that you have done your own share of self-promotion. Encourage students to *make* every opportunity to give talks and write papers. Professional rejection and failure hurts, but it won't kill you. We all have to learn to deal with failure.

We must insist that institutions change, and yet that is such a long, slow process that we can't wait for institutions to solve the problem of leadership for us. We must as individuals do all that we can to support and promote potential underrepresented minority leaders. We in this room are all examples that it can be done.

To conclude, here are some questions that I suggest as possible topics for our discussion throughout the day.

1. Can leadership be developed without first solving the underrepresented minority problem?
2. How much of a scientist does one have to be to be a successful leader? Is an end run around research desirable or advisable?
3. Is it easier to close the leadership gap than to close the scientific representation gap at level one research schools and other important places?
4. Some get Ph.D.s in science and move immediately into educational outreach or administrative positions. Should underrepresented minorities emulate this activity?
5. Can minority leadership problems be solved by minorities alone or any one segment of a population?
6. What categories do we need when evaluating success for underrepresented minorities, i.e. is it enough to treat all Hispanics as one?

I hope some of the issues I've shared with you will stimulate good conversation, thank you for coming, and now let's have some questions and discussion.

Appendix E

Web Resources: A Starter List

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Web Resources -- A Starter List:

American Association for the Advancement of Science, Making Strides <ehrweb.aaas.org/mge/>

American Indian Science and Engineering Society <www.aises.org/>

Center for Excellence and Equity in Education <ceee.rice.edu>

Commission on Professionals in Science and Technology <www.cpst.org>

Diversity Works <www.aacu-edu.org/Initiatives/diversity.htm>

GEM Consortium (National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc.) <www.nd.edu/~gem/>

Hispanic Association of Colleges and Universities <www.hacu.net>

Hispanic Engineer & Information Technology <www.hispanicengineer.com>

Leaders Growing Leaders <endowment.pwcglobal.com>

MESA (Mathematics, Engineering and Science Achievement Program) <mesa.cuop.edu/states.html>

National Action Council for Minorities in Engineering <www.nacme.org>

National Society of Black Engineers <www.nsbe.org>

Science's NextWave <nextwave.science.org/>

Society for the Advancement of Chicanos and Native Americans in Science <www.sacnas.org>

Society of Hispanic Professional Engineers <www.shpe.org>

Technica, The Official Magazine of HENAAC <www.technicamag.com>

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Prior to 1986, Chubin taught at four universities, and currently is Adjunct Professor in two Washington, DC, area programs. He has published seven books and numerous policy reports, articles, and commentaries, including Rethinking Science as a Career: Perceptions and Realities in the Physical Sciences (coauthored, 1995), and Science, Technology, and Society: A Sourcebook on Research and Practice (coedited, 2000).

Chubin is a Fellow of the American Association for the Advancement of Science (AAAS), Chair-elect of AAAS Section X-Societal Impacts of Science and Engineering, President of the Commission on Professionals in Science and Technology, and a member of the NAE Forum on Diversity in the Engineering Workforce.

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Before coming to Rice in March 1998, Lanius was a high school mathematics teacher. She maintains an extensive website of K-12 Teaching Activities that has had over a million visitors. <http://math.rice.edu/~lanius/Lessons>. She is an American Association of University Women (AAUW) Eleanor Roosevelt Teacher Fellow, a member of the National Council of Teachers of Mathematics, the Texas Computer Education Association, the Texas Association of Supervisors of Mathematics, and the AAUW. She and Tapia recently co-authored Underrepresented Minority Achievement and Course Taking: The Kindergarten-Graduate Continuum which can be found at <http://ceee.rice.edu/Books/DV/continuum/index.html>.

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Richard Tapia is Noah Harding Professor of Computational and Applied Mathematics at Rice University. He is also Director of Rice University's Center for Excellence and Equity in Education, and is Leadership Team Director for Rice's NSF-funded Alliances for Graduate Education and the Professoriate. Tapia also co-leads NSF's Education, Outreach, and Training Partnership for Advanced Computational Infrastructure.(EOT-PACI).

Tapia has authored or co-authored two books and over 80 mathematical research papers. He has delivered numerous invited addresses at national and international mathematical conferences and serves on several national advisory boards. Thirty-six mathematics students have received, or are currently working on, the Ph.D. degree under his direction or co-direction. Of these 36 students, 15 have been women and 8 have been underrepresented minorities.

Tapia's research interests are in computational sciences in general. In particular, mathematical optimization theory and iterative methods for nonlinear problems. His current research is in the area of algorithms for constrained optimization problems and interior-point methods for linear and nonlinear programming.

Among his many honors: In 1996, Tapia received the inaugural Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. In 1992, he was elected to the National Academy of Engineering, the first native born Hispanic to receive this honor.